

## **REMARKS/ARGUMENTS**

Claims 1, 5-18, 22, and 26 are pending in the above-captioned application and have been finally rejected in an Office Action dated February 12, 2004 (the Office Action). Claims 2-4, 19-21, and 23-25 have been cancelled and claims 1, 18, and 22 are currently amended.

### **Rejections under 35 U.S.C. §103**

The Office Action rejected claims 1, 3, 5-18, 20, 22, 24 and 26 as unpatentable over United States Patent No. 6,304,949 to Houlsdworth in view of United States Patent 5,761,670 to Joy.

Claim 1 recites a method of managing memory in a multi-threaded processing environment including local thread stacks and local thread heaps, and a global heap. The method, as amended, comprises the following steps or acts:

- creating an object in a thread heap;
- for a given thread, monitoring each object in its heap, to determine whether the object is accessible by any thread other than the given thread;
- assigning a status to the given object, the status designating the object as a local object;
- changing the status of the object to global when the monitoring step determines that the object is accessible from either of a global root or other global object; and
- deleting from the thread heap one or more local objects when it is determined that they are not accessible from a local root or other global object.

Houlsdworth relates to a data processing apparatus for handling multi-thread programs. The Office Action concedes that Houlsdworth does not disclose a status designating the object as local.

Houlsdworth also fails to teach or suggest the claimed "creating an object in a thread heap" -- the passages cited by the Office Action from Houlsdworth discuss a single heap for all of the objects (in particular lines 13-15 of column 4). We partition the heap into sections for the use of individual threads. These are the thread heaps mentioned in the claims. Houlsdworth says nothing about such thread heaps. Therefore, Houlsdworth neither teaches nor suggests the "creating an object in a thread heap" step.

Applicant adds that Houlsdworth further fails teach or suggest the claim limitation of "changing the status of the object to global when the monitoring step determines that the object is accessible from either of a global root or other global object."

The Office Action contends that Joy teaches the elements of "monitoring the object" and "changing the status" and that it would have been obvious to one skilled in the art to modify Houlsdworth according to Joy. Applicant respectfully submits that the claims at issue would not have been obvious in view of the combination of Houlsdworth and Joy.

We claim objects that are local or global; Joy discusses locking procedures that are local and global. Joy's global procedures, e.g., locking procedure, work for all objects. Joy's local procedure, e.g., local locking procedure is a procedure that has been specialized for a particular object. Joy's procedures have nothing to do with the claimed accessibility or thread-locality, and thus are totally unrelated to the claimed subject matter. Thus, there is no way to do dynamic tracking of locality/globality as claimed based on what Joy teaches.

Moreover, Joy neither teaches nor suggests "monitoring" as claimed. Joy mentions monitors as a way to synchronize access to objects. The word "monitor" is used in the claims in a totally different way. The meaning of "monitor" as used in the claims is the usual English language plain meaning: "to check, watch or keep track of." The claimed method monitors each object to determine the accessibility of the object from any thread other than the given thread (i.e., thread locality). The cited passage from Joy (col. 1, lines 44-52) relates to determining ownership of an object, not accessibility from other threads as claimed.

The cited references also fail to teach or suggest the claimed "changing the status of the object." The passages cited from Joy by the Office Action discuss changing the status of an object from "locked" to "unlocked" or vice versa (as a result of a program locking or unlocking an object). This is different from changing the status of an object from local to global based on accessibility or reachability (i.e., as a result of updates to objects or variables).

Moreover, the Office Action does not provide any evidence of a motivation for combining the references. Certainly, the Office Action rationale for making the combination is neither taught nor suggested by Joy or the combination of the cited references.

There is no mechanism in Joy for tracking the locality of objects; Joy specifically states

the rules which govern the placement of objects in the stack, thread local heap and global heap. The placement decision is made once and not subsequently altered. The claims by contrast specifically recite a mechanism by which an object can be assigned to a local heap and then moved to the global heap when it becomes globally accessible.

Therefore, those skilled in the art would not have been motivated by either of the cited references, whether viewed individually or in combination, to make the claimed invention.

Claims 18 and 22 are respectively machine and article of manufacture counterparts of claim 1 and those claims as well as their dependent claims are patentable for the reasons discussed above.

The Office Action contends that the limitation of claim 5 (changing the status of an object in the thread heap to global if the object is assigned to a static variable or if the object is assigned to a field in a global object) is disclosed at Houlsdworth col. 5, lines 29-30 and 43-44. As discussed, above Houlsdworth neither teaches nor suggests changing the local/global status of an object. Moreover, claim 5 is distinguishable over the cited references for the same reasons that claim 1 is patentable.

The Office Action contends that the limitation of claim 6 (intercepting assignment operations to an object in the thread heap to determine whether the object status should be changed) is disclosed by the abstract of Joy. As discussed, above Houlsdworth neither teaches nor suggests changing the local/global status of an object. Moreover, claim 6 is distinguishable over the cited references for the same reasons that claim 1 is patentable.

Claims 7-9 and 26 are distinguishable over the cited combination for reasons discussed above.

The Office Action rejected claims 10-13 as unpatentable over United States Patent No. 6,304,949 to Houlsdworth in view of United States Patent 5,761,670 to Joy and further in view of United States Patent 6,351,794 to Spilo.

The Office Action admits that the limitation of claim 10 (using spare capacity in an object header for the status) is not disclosed by either Houlsdworth or Joy but that the subject matter of claim 10 would have been obvious in view of Spilo, fig. 2, col. 5, lines 45-58. That section discusses object headers having space for variables – a well known general fact – but

says nothing about using spare capacity for status as claimed. In addition, the rationale used in the Office Action for combining three disparate references was that the combination would make garbage collection faster and more precise. That is an inadequate and unsupported (by any evidence of record) rationale for combining the references. First, the statement is so general that if that were sufficient, then any combination of references could be combined thus rendering an entire class of valuable inventions obvious. That cannot be the standard for obviousness. Moreover, claim 10 is distinguishable over the cited references for the same reasons that claim 1 is patentable.

The Office Action contends that the limitation of claim 11 (using multiples of 2 or more bytes in a thread heap to store the objects) is disclosed at Houlsdworth col. 5, line 45 – col. 6, line 2. However, the Office Action does not even allege that the limitation “whereby there is at least one spare bit in the object length variable and using the at least one spare bit as the status” is disclosed anywhere in the cited references. Moreover, claim 11 is distinguishable over the cited references for the same reasons that claim 1 is patentable.

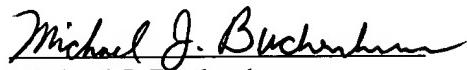
The Office Action contends that the limitation of claim 12 (moving objects whose status is global from the thread heap to the global heap) is disclosed at Spilo fig. 5, and col.11, lines 33-39. Applicant respectfully traverses this statement. Spilo neither teaches nor suggests this limitation. The cited portion discusses moving half of the TCBs in the local pool to the global pool when the local pool overflows. That has nothing to do with the claimed limitation.

The Office Action contends that the limitation of claim 13 (compacting the reachable local objects in a thread heap) is disclosed at Houlsdworth col. 2, lines 49-65. Applicant respectfully traverses this statement. That section discusses compacting memory space by moving objects it finds to another region. It says nothing about the thread heap.

Claims 14-17 are patentable for the reasons discussed above.

For the foregoing reasons, Applicant respectfully requests allowance of the pending claims and that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

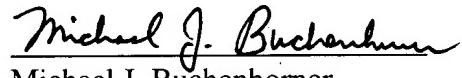
  
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I hereby certify that this Amendment and Response to Office Action is being deposited with the United States Postal Service as First Class Mail, in an envelope addressed to: Commissioner for Patents, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 on May 12, 2004.

  
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Date: May 12, 2004